Extended Rotations for Midwest U.S. Cropping Systems

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Rationale:

The United States has a corn-based cropping system that supports the very successful production of food, fuel and fiber. However, this system has some unintended environmental consequences, including contributions to hypoxia in the Gulf of Mexico and production of greenhouse gases (GHGs). Increased climate uncertainty and change are likely to threaten long term sustainability and resilience of the system unless mitigation and adaptive strategies are identified and implemented.

Crop rotations have the potential to maximize soil organic carbon retention and sequestration thereby mitigating the impacts of climate change. Increasing the diversity of cropping systems has the potential to maximize resiliency of the corn-based system under variable climate conditions. Currently in the Midwest U.S. Corn Belt many counties have more than 85% of their agricultural land area in a corn-soybean crop rotation. Continuous planting of corn is often the rotation treatment of choice when price opportunities arise. Approximately 20% of all acres in the Midwest Corn Belt are in continuous corn. This number is likely to increase in the future as corn grows in importance as a feedstock for biofuel production.

Our hypothesis is that GHG emissions can be decreased and carbon retention and sequestration increased by using extended crop rotations.

Year	Rotation treatment							
2015	C	S	W	C	S	S	W	C
2014	C	S	W	S	C	C	S	W
2013	C	S	W	C	S	W	C	S
2012	C	S	W	C	S	S	W	C
2011	C	S	W	S	C	C	S	W
2010	C	S	W	C	S	W	C	S

C= Corn, S= Soybean, W= Wheat

Objective

To measure soil quality, carbon (C) sequestration, GHGs, and inorganic N, and correlate these measurements with crop management practices on C, N, and water footprints. Each site has a corn (*Zea mays* L.)-soybean (*Glycine max* L.)-wheat (*Triticum aestivum* L.) rotation that will be used for baseline measurements.

Materials and Methods

Our hypothesis will be tested by using data collected from long-term established rotation experiments. Yield and quality data will be cross-referenced with weather data for the experimental sites. This information will be used by modelers to project corn production levels for various climate change scenarios.

Carbon Sequestration and Calculation of Carbon Sequestration Index. Soil C and N profiles will be measured from the data on their respective concentration and bulk density for specific soil depth. C sequestration rate (kg C/ha/yr) will be measured with reference to the baseline.

Soil Quality Index. Data will be collated to calculate the Soil Quality Index (SQI). SQI will be measured for all sites in Year 1 and at least alternative years thereafter. SQI will be related to ecosystem services (e.g., crop yield, CO_2 off sets).

Weather data, including precipitation, air temperature, soil temperature, and solar radiation will be collected for all sites using the standard methodology by the Weather Bureau.

Agronomic indicators, including plant biomass, grain yield, grain moisture, grain total C, total N and plant population will be determined for all sites.